

### Controlling *Escherichia coli* O157:H7 in Fresh Beef Products

#### Priority Focus

Is *E. coli* O157:H7 contamination on blade tenderized and/or enhanced whole muscle beef products a potential public health concern? Enhanced whole muscle beef products include any product that is marinated and/or have some added aqueous solution that is distributed to the internal core of the whole muscle through injection, tumbling, *etc.*

- Will common microbial interventions reduce potential contamination?
- Translocation and Risk. Research should include more realistic inoculation levels (*e.g.*  $10^4$ ) to mimic potential in-plant contamination scenarios. Proposals also should address application of common commercial interventions to demonstrate the efficacy of treatments in minimizing the translocation of microbial contamination.
- Survival during Cooking. Research should include direct internal inoculation of whole muscle products mimicking needle/mechanical tenderization. The inoculation levels should range from low levels ( $10^2$ ) to higher levels ( $10^4$ ) which more accurately reflect potential contamination in commercial settings. The proposal should address any protective effects an enhancement solution may have on microbial survival during cooking. Proposed research should also demonstrate lethality during common cooking practices.

Determine the most effective location(s) in the production chain for ground beef to apply interventions to maximize reduction of microbial contamination? Please consider the following questions:

- Does the application of pre-harvest interventions in a food safety system reduce *E. coli* O157:H7 contamination in ground beef products?
- Does the application of carcass washes and/or other post-harvest interventions in a food safety system reduce *E. coli* O157:H7 contamination in ground beef products?

#### **Pre-Harvest Research (Pre-harvest is defined as the time period prior to cattle being slaughtered.)**

- Lairage has been identified as a risk factor for *E. coli* O157:H7 contamination of hides for cattle delivered to processing plants. Proposals should identify practical intervention technologies to reduce levels of *E. coli* O157:H7 at lairage.
- Develop easy to adopt hide treatment technology to reduce *E. coli* O157:H7 load on cattle presented for harvest.
- Develop greater understanding of the ecology/epidemiology of *E. coli* O157:H7 as well as non-O157 Shiga-toxin producing *E. coli* (STEC) (O26, O103, O111, O121, O45, and O145).
- Determine the mechanism for intestinal colonization of *E. coli* O157:H7 and STEC (O26, O103, O111, O121, O45, and O145) and corresponding opportunities for control.
- Determine the most effective location(s) in the production chain for ground beef to apply interventions to maximize reduction of microbial contamination? (see **Priority Focus** for additional detail).

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## Post-Harvest Research (Post-harvest is defined as the time period following cattle being slaughtered.)

- Determine the most effective location(s) in the production chain for ground beef to apply interventions to maximize reduction of microbial contamination? Please consider the following questions:
  - Does the application of pre-harvest interventions in a food safety system reduce *E. coli* O157:H7 contamination in ground beef products?
  - Does the application of carcass washes and/or other post-harvest interventions in a food safety system reduce *E. coli* O157:H7 contamination in ground beef products?
- Identify and validate novel intervention technologies for *E. coli* O157:H7 and/or non-O157 shiga-toxin producing *E. coli* (STEC) (O26, O103, O111, O121, O45, and O145).
- Evaluate the effect of the plant environment (*e.g.* air, machinery, employees) in the role of transmission of *E. coli* O157:H7.
- Determine a novel method of reducing transfer of *E. coli* O157:H7 from the hide to the carcass.
- Evaluate the statistical validity of existing and alternative sampling methods for *E. coli* O157:H7 in beef trim and finished products.
- Identify and validate novel intervention technologies for *E. coli* O157:H7 in trim. The proposal should address the impact of the intervention on the organoleptic properties and shelf-life.
- Validate existing and commonly used intervention technologies for *E. coli* O157:H7 and/or non-O157 STECs (O26, O103, O111, O121, O45, and O145).
- Develop a standard protocol for validating finished product sampling, specifically in ground beef.
- Examine the D-values for microorganisms in irradiated products. Are there differences between O157:H7 and non-O157:H7 STECs (O26, O103, O111, O121, O45, and O145) and/or gram-positive and negative microorganism?
- Is *E. coli* O157:H7 contamination on blade tenderized and/or enhanced whole muscle beef products a potential public health concern? Enhanced whole muscle beef products include any product that is marinated and/or have some added aqueous solution that is distributed to the internal core of the whole muscle through injection, tumbling, *etc.* (see **Priority Focus** for additional detail).
- Compare the application of antimicrobials using traditional spray methods and application via electrostatic spray. The proposal should address the efficacy of the treatments, application levels and any potential waste/loss of antimicrobial solutions based on the type of application.

## Information to Enhance Current and Future *E. coli* O157:H7 Risk Assessments

- Address data needs identified in the FSIS Draft Risk Assessment for *E. coli* O157:H7.
- Conduct an analysis of the combination of virulence factors required to cause human illness.
- Develop data to support future risk assessments of *E. coli* O157:H7 and non-O157 shiga-toxin producing *E. coli* (STEC) (O26, O103, O111, O121, O45, and O145) and to estimate the human health risk attributable to beef products.

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## **Controlling *Listeria monocytogenes* on Ready-to-Eat Meat and Poultry Products**

### **Priority Focus**

Improve and augment epidemiological data on food attribution for listeriosis, both sporadic and outbreak cases. The proposal should recognize the following assumptions:

- The Food and Drug Administration/Food Safety and Inspection Service *Listeria* Risk Assessment indicate ready-to-eat deli items are responsible for a majority of foodborne listeriosis cases in the U.S.
- USDA's Food Safety and Inspection Service (FSIS) data indicate the prevalence of *Listeria monocytogenes* (*Lm*) on RTE meat and poultry products has been declining from 2.54% contamination rate in 1998 to 0.45% in 2008, while the Centers for Disease Control and Prevention (CDC) 2009 FoodNet data indicate listeriosis cases only declined from 5 cases/million in 1996 to 3.4 cases/million in 2009. If a majority of the listeriosis cases are indeed caused by contaminated deli meats, a much more considerable decline of human listeriosis cases should have occurred over the last 10 years. Research is thus needed to understand the reason behind this apparent discrepancy between the risk assessment data and the FSIS and CDC data on food contamination with *Lm* and human listeriosis cases in order to facilitate further targeted interventions to reduce human listeriosis cases.
- Identify data gaps in the attribution of listeriosis cases related to distribution, retail and consumption of deli sliced meats, specifically meats sliced in retail delis.
- Identify and examine potential transmission and/or contamination vectors in a retail deli environment, including personnel and non-meat RTE deli products.
- Identify interventions to reduce the transmission and/or cross-contamination of *Lm* in the retail deli environment.

### **Innovative Pathogen Intervention Technologies**

- Identify and validate bactericidal and/or bacteriostatic ingredients or treatments. Proposals should address existing FSIS and FDA regulations (e.g. FSIS Supplementary Guidance - [http://www.fsis.usda.gov/OPPDE/rdad/FRPubs/97-013F/Lm\\_Supplementary\\_Guidance.pdf](http://www.fsis.usda.gov/OPPDE/rdad/FRPubs/97-013F/Lm_Supplementary_Guidance.pdf), FDA approval status). Additionally, proposals should define the meaning of bacteriostatic and bacteriocidal in the context of existing regulations. Proposals should include an evaluation of the impact on sensory attributes, cost and application method.
- Identify factors involved in regulation of genes that influence the organism's ability to thrive in RTE processing environments, on food contact surfaces and/or on products. Identify potential synergistic effects of existing hurdles related to gene expression. Proposals should include an evaluation of differences among serotypes and impact of meat species type.
- Validate existing and commonly used intervention technologies for *Lm* and how they impact *Salmonella* survival in fully cooked RTE meat and poultry products. The proposal should address additives and ingredients; and thermal processes.
- Compare the application of antimicrobials using traditional spray methods and application via electrostatic spray. The proposal should address the efficacy of the treatments, application levels and any potential waste/loss of antimicrobial solutions based on the type of application.

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## **Operational Control and Monitoring of the Processing Environment**

- Identify methods of preventing microbiological recontamination of sliced, diced, chopped and/or shredded meats.
- Validate the expected impact of operational controls such as clean room technologies, facility and equipment cleaning procedures.
- Develop and validate measures of effectiveness of existing controls. Proposals should address issues specific to small and very small plants.
- Evaluate real-time or near real-time *Listeria* sampling and testing technologies.
- Develop improved and validated quantitative methods for *Lm* detection in foods and environmental samples.

## **Post-Production Research**

- Identify and examine potential transmission and/or contamination vectors in a retail deli environment, including personnel and non-meat RTE deli products.
- Identify interventions to reduce the transmission and/or cross-contamination of *Lm* in the retail deli environment.

## **Risk Assessment**

- Improve and augment epidemiological data on food attribution for listeriosis, both sporadic and outbreak cases. (see **Priority Focus** for additional detail)

## **Controlling *Salmonella* in Meat and Poultry Products**

<b>Priority Focus</b>
<ul style="list-style-type: none"><li>• Develop data to support future risk assessments of <i>Salmonella</i> and to estimate the human health risk attributable to beef, pork and/or poultry products.</li></ul>



## **Innovative Pathogen Intervention Technologies**

- Identify likely sources of contamination, risk factors, and how to systematically intervene at the production facility, during transportation and lairage and the levels of *Salmonella* present on carcasses and meat products.
- Investigate and validate novel intervention technologies for *Salmonella* in meat and poultry products.
- Determine the effectiveness of existing or new intervention technologies on multiple serovars of *Salmonella* including those that are multi-drug resistant (*Salmonella* Typhimurium DT 104; and *Salmonella* Newport MDR-AmpC).
- Identify the potential for *Salmonella* harbors within the post-harvest processing environment and interventions to reduce or eliminate the presence of *Salmonella* in the identified harbors.
- Validate existing and commonly used intervention technologies for *Listeria monocytogenes* and how they impact *Salmonella* survival in fully cooked RTE meat and poultry products. The proposal should address additives and ingredients; and thermal processes.
- Identify interventions that can be applied to the pork carcass and/or trim to reduce the prevalence of *Salmonella* in pork trim. The intervention's impact on organoleptic properties should be evaluated.

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### **Innovative Pathogen Intervention Technologies (continued)**

- Evaluate whether commonly used interventions for beef carcasses are effective for pork carcasses in reducing *Salmonella*. The proposal should:
  - Develop a protocol to allow for every carcass (beef or pork) to be continually sampled.
  - Are there other indicators that could be accurately and rapidly measured to determine an “event” day occurrence within a slaughter processing facility?
  - The protocol should evaluate implementation in commercial environments.
- Develop novel interventions to reduce the likelihood of *Salmonella* contamination in products that appear RTE but are not RTE (*i.e.* uncooked, breaded, boneless poultry products that also may be stuffed or filled, charmarked, or artificially colored). The proposal should:
  - Address potential undercooking of products and how growth can be inhibited; and
  - Evaluate the organoleptic properties of the intervention.
- Compare the application of antimicrobials using traditional spray methods and application via electrostatic spray. The proposal should address the efficacy of the treatments, application levels and any potential waste/loss of antimicrobial solutions based on the type of application.

### **Information to Enhance Current and Future *Salmonella* Public Health Risk Assessments**

- Develop cost-effective quantitative sampling and analytical methods for *Salmonella* on raw meat and poultry products that will provide meaningful data for enhancing public health.
- Investigate the epidemiology of multi-drug resistant *Salmonella* within the production chain and quantify the human health risks associated with these organisms.
- Identify the relationship between prevalence of *Salmonella* on pork carcasses with prevalence on pork trim and their relationship to human illness.
- Develop data to support future risk assessments of *Salmonella* and to estimate the human health risk attributable to beef, pork and/or poultry products.

### **Other Food Safety Research**

#### **White Paper on *C. difficile* as a Risk Associated with Animal Sources.**

The paper should include the following components:

- Summarize all historical data on *C. difficile* and its relationship with animal and non-animal related infections;
- Evaluate hospital nosocomial *C. difficile* infections;
- Evaluate worldwide understanding of *C. difficile* infections and their sources; and
- Identify the data gaps, state how these gaps influence the understanding of *C. difficile*, and propose tasks needed to close the gaps.

#### **How do the temperature and dwell time of carcass washes impact the reduction of *Mycobacterium bovis*?**

The proposal should address:

- Temperature inactivation ranges (*e.g.* 165 – 180°F)
- Application time of water (*e.g.* 6.5-11 seconds)
- Recirculation
- Subsequent downstream interventions (Lactic acid spray, peroxyacetic acid spray, *etc.*)